Monitoring Analytics

# REPORT TO THE OHIO PUBLIC UTILITY COMMISSION

## Congestion in the State of Ohio:

## January 1, 2010 through April 30, 2011

The Independent Market Monitor for PJM

July 15, 2011

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# Overview of Congestion Calculations

This report provides details of congestion associated with the PJM related buses in the state of Ohio for the calendar year 2010 and January 1, 2011 through April 30, 2011.[1] Congestion calculations throughout this report are for the PJM related buses wholly within the state of Ohio and not for any specific organization. The total congestion calculations are the sum of all the congestion calculations for the organizations with market activity in the area. The report also includes congestion event hours for the constraints which had the largest impact on congestion charges in PJM related buses in the state of Ohio, either positive or negative, and the congestion charges associated with each constraint. [2]

Total congestion costs equal net congestion costs plus explicit congestion costs. Net congestion costs equal load congestion payments minus generation congestion credits.[3] Explicit congestion costs are the net congestion costs associated with point-to-point energy transactions. Each of these categories of congestion costs is comprised of day-ahead and balancing congestion costs. Day-ahead congestion costs are based on day-ahead MWh while balancing congestion costs are based on deviations between day-ahead and real-time MWh priced at the congestion price in the Real-Time Energy Market. [4]

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1 Any discussion of Ohio congestion in the following report is referring to congestion associated with PJM related buses within the state of Ohio, rather than the entire state of Ohio.

2 Congestion event hours are hours in which a transmission constraint is binding. In day ahead, an interval equals one hour. In real time, an interval equals five minutes. In order to have a consistent metric for day-ahead and real-time congestion frequency, real-time congestion frequency is measured using the convention that an hour is constrained if any one of its component five-minute intervals is constrained.

3 Prior to June 1, 2007, PJM Congestion Accounting methods included implicit congestion costs, spot congestion costs, and explicit congestion costs, After June 1, 2007, PJM no longer calculates spot congestion costs. Implicit congestion costs are now equal to the difference between load congestion payments and generation credits, i.e. net congestion. Explicit congestion costs remained the same after June 1, 2007.

4 See Table 9 , "Congestion Definitions," for a summary of relevant definitions.

Table 1 shows a summary of the total congestion costs in Ohio for calendar year 2010 and the first four months of 2011. Table 2 shows a monthly breakdown of congestion costs for calendar year 2010 and the first four months of 2011.

**Table 1 Total Ohio congestion costs (Dollars (Millions)): Calendar year 2010 and January 1, 2011 through April 30, 2011**

| | Congestion Costs |
|---|---|
| 2010 | ($28.5) |
| 2011 (Jan - Apr) | $3.3 |
| Total | ($25.1) |

**Table 2 Monthly Ohio congestion costs (Dollars (Millions)): Calendar year 2010 and January 1, 2011 through April 30, 2011**

| | Total Congestion Costs | | |
|---|---|---|---|
| | 2010 | 2011 | Change |
| Jan | ($4.7) | ($4.7) | ($0.0) |
| Feb | ($3.5) | $2.2 | $5.7 |
| Mar | ($0.3) | $4.9 | $5.2 |
| Apr | ($2.5) | $0.9 | $3.4 |
| May | ($3.4) | | |
| Jun | ($1.0) | | |
| Jul | ($0.2) | | |
| Aug | ($0.0) | | |
| Sep | ($2.1) | | |
| Oct | ($0.3) | | |
| Nov | ($0.8) | | |
| Dec | ($9.7) | | |

Congestion charges can be both positive and negative. When a constraint binds, the price effects of that constraint vary. The system marginal price (SMP) is uniform for all areas, while the congestions components of Locational Marginal Price (LMP) will either be positive or negative in a specific area, meaning that actual LMPs are above or below the SMP.[5] The area affected by a constraint will have increased prices and the unconstrained area will have lower prices. If an area is located downstream from the constrained element, the area will experience positive congestion costs. If an area is

[5] The SMP is the price of the distributed load reference bus. The price at the reference bus is equivalent to the five minute real-time or hourly day-ahead load weighted PJM LMP.

located upstream from the constrained element, the area will experience negative congestion costs (lower prices).

Day-ahead congestion charges and credits are based on MWh and LMP in the Day-Ahead Energy Market. Balancing congestion charges and credits are based on load or generation deviations between the Day-Ahead and Real-Time Energy Markets and LMP in the Real-Time Energy Market. If a participant has real-time generation or load that is greater than its day-ahead generation or load then the deviation will be positive. If there is a positive load deviation at a bus where real-time LMP has a positive congestion component, positive balancing congestion costs will result. Similarly, if there is a positive load deviation at a bus where real-time LMP has a negative congestion component, negative balancing congestion costs will result. If a participant has real-time generation or load that is less than its day-ahead generation or load then the deviation will be negative. If there is a negative load deviation at a bus where real-time LMP has a positive congestion component, negative balancing congestion costs will result. Similarly, if there is a negative load deviation at a bus where real-time LMP has a positive congestion component, negative balancing congestion costs will result.

In order to provide a more detailed explanation of the congestion calculations from which the total congestion charges are derived, each category of congestion is defined and a table of the congestion charges or credits associated with each category is provided.

## *Net Congestion Bill*

The net congestion bill is defined by PJM settlements. The net congestion bill is calculated by subtracting generating congestion credits from load congestion payments. The logic is that increased congestion payments by load are offset by increased congestion revenues to generation, for the area analyzed. Whether the net congestion bill is an appropriate measure of congestion for load depends on who pays the load congestion payments and who receives the generation congestion credits. The net congestion bill is an appropriate measure of congestion for a utility that charges load congestion payments to load and credits generation congestion credits to load. The net congestion bill is not an appropriate measure of congestion in situations where load pays the load congestion payments but does not receive the generation credits as an offset.

Load congestion payments are netted against generation congestion credits on an hourly basis, by participant, and then summed for the given period. Generation credits result either from the direct ownership of generation or from the purchase of supply from another entity via a bilateral transaction.

Both day-ahead and balancing load congestion payments and generation congestion credits are calculated.

- **Day-ahead Load Congestion Payments.** Day-ahead load congestion payments are calculated for all cleared demand, decrement bids, and day-ahead energy sale transactions. (Decrement bids and energy sales can be thought of as scheduled load.) Day-ahead load congestion payments are calculated using load MWh and the congestion component of LMP (CLMP) for the load bus, decrement bid location, or the source of the sale transaction, as applicable.

- **Day-ahead Generation Congestion Credits.** Day-ahead generation congestion credits are calculated for all cleared generation and increment offers and day-ahead energy purchase transactions. (Increment offers and energy purchases can be thought of as scheduled generation.) Day-ahead generation congestion credits are calculated using generation MWh and the CLMP for the generator bus, increment offer location, or the sink of the purchase transaction, as applicable.

- **Balancing Load Congestion Payments.** Balancing load congestion payments are calculated for all deviations between a PJM participant's real-time load and energy sale transactions and their day-ahead cleared demand, decrement bids, and energy sale transactions. Balancing load congestion payments are calculated using MWh deviations and the real-time CLMP for each bus where a deviation from a member's day-ahead scheduled load exists.

- **Balancing Generation Congestion Credits.** Balancing generation congestion credits are calculated for all deviations between a PJM participant's real-time generation and energy purchase transactions and the day-ahead cleared generation, increment offers and energy purchase transactions. Balancing generation congestion credits are calculated using MWh deviations and the real-time CLMP for each bus where a deviation from a member's day-ahead scheduled generation exists.

## Explicit Congestion Costs

Explicit congestion costs are the congestion costs associated with moving energy from one specific point to another across the transmission system. Such point-to-point transactions may be either internal to PJM or be import or export transactions.

- **Internal Purchases**. For internal purchases the explicit congestion costs equal the difference in CLMPs between the sink bus and source bus of the purchase multiplied by the transacted MWh. The buyer pays the congestion costs associated with internal purchases.

- **Import and Export Transactions.** For point-to-point and network secondary transmission customers, the explicit congestion costs equal the differences in CLMPs between the sink bus and source bus multiplied by the transacted MWh. The transmission customer pays the congestion costs associated with and import or export transaction.

The explicit congestion costs calculated for Ohio represent the costs associated with point-to-point transactions that sink in Ohio. For example, if a transaction is sourced in Pennsylvania and sinks in Ohio, the charges would be based on the MWh of the transaction multiplied by the difference between the sink CLMP and the source CLMP. The resulting congestion costs are allocated to the zone and state of the sink location, in this case all of the zones contained in Ohio. The sink location is the buyer's location and reflects the cost to the buyer of the internal purchase or external transaction.

Table 3 shows the combined day-ahead and balancing load congestion payments, generation congestion credits, and explicit congestion costs for Ohio for calendar year 2010 and the first four months of 2011. Table 4 shows the congestion cost categories separated by day-ahead and balancing to show the contributions from both the Day-Ahead and Real-Time Markets for calendar year 2010 and the first four months of 2011.

**Table 3 Total Ohio congestion costs by category: Calendar years 2010 and January 1, 2011 through April 30, 2011**

| Congestion Costs (Millions) | | | | | |
|---|---|---|---|---|---|
| | Load Payments | Generation Credits | Net Congestion Bill | Explicit | Grand Total |
| 2010 | ($116.5) | ($92.7) | ($23.8) | ($4.7) | ($28.5) |
| 2011 (Jan - Apr) | ($33.2) | ($40.8) | $7.6 | ($4.3) | $3.3 |

**Table 4 Total day-ahead and balancing Ohio congestion costs by category: Calendar years 2010 and January 1, 2011 through April 30, 2011**

| Congestion Costs (Millions) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Day Ahead | | | | Balancing | | | | |
| | Load Payments | Generation Credits | Explicit | Total | Load Payments | Generation Credits | Explicit | Total | Grand Total |
| 2010 | ($100.3) | ($114.0) | $2.2 | $15.9 | ($16.1) | $21.4 | ($6.9) | ($44.4) | ($28.5) |
| 2011 (Jan - Apr) | ($30.4) | ($51.6) | ($3.3) | $18.0 | ($2.9) | $10.8 | ($1.0) | ($14.6) | $3.3 |

Table 5 lists the top 15 constraints affecting Ohio congestion costs for the first four months of 2011. Table 5 provides the type of constraint (Line, Transformer, Flowgate or Interface), the location of the constraint and the congestion event hours for the period analyzed.

**Table 5 Top 15 constraints affecting Ohio congestion costs: January 1, 2011 through April 30, 2011**

| No. | Constraint | Type | Location | Event Hours Day Ahead | Event Hours Real Time |
|---|---|---|---|---|---|
| 1 | Belmont | Transformer | AP | 1,721 | 105 |
| 2 | AP South | Interface | 500 | 1,435 | 547 |
| 3 | Wylie Ridge | Transformer | AP | 1,377 | 329 |
| 4 | Wolfcreek | Transformer | AEP | 1,064 | 94 |
| 5 | 5004/5005 Interface | Interface | 500 | 513 | 241 |
| 6 | AEP-DOM | Interface | 500 | 293 | 90 |
| 7 | Muskingum River | Transformer | AEP | 178 | 0 |
| 8 | West | Interface | 500 | 261 | 12 |
| 9 | Cloverdale - Lexington | Line | AEP | 336 | 217 |
| 10 | South Mahwah - Waldwick | Line | PSEG | 2,409 | 410 |
| 11 | Chaparral - Carson | Line | Dominion | 0 | 180 |
| 12 | Carnegie - Tidd | Line | AEP | 323 | 308 |
| 13 | Susquehanna | Transformer | PPL | 120 | 0 |
| 14 | Baker - Broadford | Line | AEP | 8 | 20 |
| 15 | Sporn - Kyger Creek | Line | AEP | 261 | 0 |

Table 6 shows the congestion cost details of the top 15 constraints affecting Ohio congestion costs for the first four months of 2011.

**Table 6 Congestion cost details for the top 15 constraints affecting Ohio: January 1, 2011 through April 30, 2011**

| | Congestion Costs (Millions) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Day Ahead | | | | Balancing | | | | |
| Constraint | Load Payments | Generation Credits | Explicit | Total | Load Payments | Generation Credits | Explicit | Total | Grand Total |
| Belmont | $7.7 | ($1.9) | $1.4 | $11.1 | ($0.9) | ($0.2) | ($1.5) | ($2.1) | $9.0 |
| AP South | ($11.7) | ($11.5) | ($1.8) | ($2.0) | ($0.6) | $3.4 | $1.5 | ($2.5) | ($4.6) |
| Wylie Ridge | ($5.8) | ($5.1) | ($1.1) | ($1.8) | ($0.3) | $1.1 | $0.6 | ($0.7) | ($2.5) |
| Wolfcreek | $0.3 | ($2.0) | $0.5 | $2.7 | ($0.2) | $0.1 | ($0.4) | ($0.7) | $2.0 |
| 5004/5005 Interface | ($7.3) | ($7.8) | ($0.5) | ($0.1) | ($0.5) | $1.4 | $0.4 | ($1.5) | ($1.6) |
| AEP-DOM | ($0.9) | ($2.2) | $0.0 | $1.4 | ($0.0) | $0.3 | $0.1 | ($0.2) | $1.2 |
| Muskingum River | $0.2 | ($0.4) | $0.2 | $0.8 | $0.0 | $0.0 | $0.0 | $0.0 | $0.8 |
| West | ($1.1) | ($1.9) | ($0.1) | $0.7 | $0.0 | $0.0 | $0.0 | ($0.0) | $0.7 |
| Cloverdale - Lexington | ($0.5) | ($0.7) | $0.1 | $0.3 | $0.1 | $0.8 | ($0.2) | ($0.9) | ($0.5) |
| South Mahwah - Waldwic | ($1.2) | ($1.3) | $0.1 | $0.2 | ($0.0) | $0.5 | ($0.2) | ($0.8) | ($0.5) |
| Chaparral - Carson | $0.0 | $0.0 | $0.0 | $0.0 | ($0.0) | $0.2 | ($0.3) | ($0.5) | ($0.5) |
| Carnegie - Tidd | ($0.2) | ($0.7) | ($0.2) | $0.2 | ($0.0) | $0.2 | $0.5 | $0.3 | $0.5 |
| Susquehanna | ($0.4) | ($0.8) | ($0.0) | $0.4 | $0.0 | $0.0 | $0.0 | $0.0 | $0.4 |
| Baker - Broadford | ($0.0) | ($0.1) | $0.0 | $0.1 | $0.0 | $0.5 | $0.1 | ($0.4) | ($0.3) |
| Sporn - Kyger Creek | ($0.0) | $0.0 | $0.3 | $0.3 | $0.0 | $0.0 | $0.0 | $0.0 | $0.3 |

Table 7 lists the top 15 constraints affecting Ohio congestion costs for calendar year 2010. Table 7 provides the type of constraint (Line, Transformer, Flowgate or Interface), the location of the constraint and the congestion event hours for the period analyzed.

**Table 7 Top 15 constraints affecting Ohio congestion costs: Calendar year 2010**

| No. | Constraint | Type | Location | Event Hours Day Ahead | Event Hours Real Time |
|---|---|---|---|---|---|
| 1 | AP South | Interface | 500 | 4,646 | 1,528 |
| 2 | Belmont | Transformer | AP | 1,887 | 203 |
| 3 | Tiltonsville - Windsor | Line | AP | 2,723 | 506 |
| 4 | Wylie Ridge | Transformer | AP | 945 | 688 |
| 5 | 5004/5005 Interface | Interface | 500 | 1,644 | 605 |
| 6 | Bedington - Black Oak | Interface | 500 | 2,291 | 212 |
| 7 | AEP-DOM | Interface | 500 | 691 | 187 |
| 8 | Mahans Lane - Tidd | Line | AEP | 646 | 207 |
| 9 | East Frankfort - Crete | Line | ComEd | 3,084 | 850 |
| 10 | Millville - Old Chapel | Line | AP | 210 | 303 |
| 11 | Brues - West Bellaire | Line | AEP | 0 | 78 |
| 12 | Doubs | Transformer | AP | 1,365 | 525 |
| 13 | Erie West | Transformer | PENELEC | 1,203 | 175 |
| 14 | Pleasant Prairie - Zion | Flowgate | Midwest ISO | 1,098 | 310 |
| 15 | Crescent | Transformer | DLCO | 740 | 174 |

Table 8 shows the congestion cost details of the top 15 constraints affecting Ohio congestion costs for calendar year 2010.

**Table 8 Congestion cost details for the top 15 constraints affecting Ohio: Calendar year 2010**

| | Congestion Costs (Millions) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Day Ahead | | | | Balancing | | | | |
| Constraint | Load Payments | Generation Credits | Explicit | Total | Load Payments | Generation Credits | Explicit | Total | Grand Total |
| AP South | ($33.1) | ($28.7) | ($3.1) | ($7.6) | ($3.4) | $3.6 | $2.0 | ($5.0) | ($12.7) |
| Belmont | $8.8 | $1.4 | $1.6 | $9.0 | ($2.4) | ($0.7) | ($1.0) | ($2.7) | $6.3 |
| Tiltonsville - Windsor | ($6.7) | ($5.0) | ($0.9) | ($2.6) | ($0.6) | $1.6 | $1.2 | ($0.9) | ($3.5) |
| Wylie Ridge | ($6.0) | ($5.0) | ($0.5) | ($1.5) | ($1.1) | $1.2 | $0.3 | ($1.9) | ($3.5) |
| 5004/5005 Interface | ($10.2) | ($10.1) | ($0.7) | ($0.8) | ($1.2) | $1.8 | $0.7 | ($2.3) | ($3.0) |
| Bedington - Black Oak | ($10.8) | ($9.6) | ($0.9) | ($2.1) | ($0.2) | $0.7 | $0.4 | ($0.5) | ($2.6) |
| AEP-DOM | ($4.5) | ($7.2) | $0.4 | $3.0 | ($0.5) | $0.9 | $0.3 | ($1.1) | $1.9 |
| Mahans Lane - Tidd | ($1.0) | ($2.9) | ($0.3) | $1.6 | $0.2 | $0.1 | $0.1 | $0.2 | $1.8 |
| East Frankfort - Crete | $2.8 | $2.2 | $1.5 | $2.1 | $0.3 | $0.0 | ($0.7) | ($0.4) | $1.6 |
| Millville - Old Chapel | ($0.9) | ($0.9) | ($0.0) | ($0.0) | ($0.5) | $1.3 | $0.2 | ($1.6) | ($1.6) |
| Brues - West Bellaire | $0.0 | $0.0 | $0.0 | $0.0 | ($1.1) | $0.4 | ($0.1) | ($1.6) | ($1.6) |
| Doubs | ($5.5) | ($5.3) | ($0.2) | ($0.4) | ($0.6) | $0.7 | $0.2 | ($1.2) | ($1.6) |
| Erie West | ($2.1) | ($1.7) | ($0.1) | ($0.6) | ($0.3) | $0.3 | $0.1 | ($0.5) | ($1.1) |
| Pleasant Prairie - Zion | $0.0 | ($0.0) | $0.6 | $0.7 | $0.0 | $0.0 | ($1.7) | ($1.7) | ($1.0) |
| Crescent | ($0.5) | $0.2 | $0.0 | ($0.7) | ($0.1) | $0.0 | ($0.0) | ($0.2) | ($0.8) |

## *Conclusion*

During the first four months of 2011, total congestion costs in Ohio overall were positive. Ohio is situated west of the major transmission constraints in PJM and generally experiences lower congestion costs relative to the eastern and southern portions of PJM. When congestion event hours increase on these major west to east transmission constraints, there is generally downward pressure on LMP and congestion costs in Ohio relative to locations in the eastern portion of PJM. This contributes to negative congestion costs in Ohio. Conversely, when congestion event hours decrease on these major west to east transmission constraints, there is upward pressure on congestion costs in Ohio. A large proportion of the negative congestion costs in Ohio were the result of the AP South Interface. Most of the positive congestion costs in Ohio were the result of the Belmont Transformer. Most of Ohio is situated on the high price side of the Belmont Transformer and on the low price side of the AP South Interface. Ohio's total congestion costs in 2010 were -$28.5 million, with AP South Interface contributing -$12.7 million compared to Belmont Transformer's $6.3 million. In contrast, Ohio's total congestion costs during the first four months 2011 were $3.3 million. During the first four months of 2011, congestion costs resulting from the Belmont Transformer were $9 million while congestion costs resulting from AP South were -$4.6 million.

# Congestion Definitions

## Table 9 Congestion Definitions

| Congestion Category | Calculation |
|---|---|
| Day-Ahead Load Congestion Payments | Day-Ahead Demand MWh * Day-Ahead CLMP |
| Day-Ahead Generation Congestion Credits | Day-Ahead Supply MWh * Day-Ahead CLMP |
| Day-Ahead Net Congestion Bill | Day-Ahead Load Congestion Payments - Day-Ahead Generation Congestion Credits |
| Day-Ahead Explicit Congestion Costs | Day-Ahead Transaction MW * (Day-Ahead Sink CLMP - Day-Ahead Source CLMP) |
| Day-Ahead Total Congestion Costs | Day-Ahead Load Congestion Payments - Day-Ahead Generation Congestion Credits + Day-Ahead Explicit Congestion Costs |
| Balancing Load Congestion Payments | Balancing Demand MWh * Real-Time CLMP |
| Balancing Generation Congestion Credits | Balancing Supply MWh * Real-Time CLMP |
| Balancing Net Congestion Bill | Balancing Load Congestion Payments - Balancing Generation Congestion Credits |
| Balancing Explicit Congestion Costs | Balancing Transaction MW * (Real-Time Sink CLMP - Real-Time Source CLMP) |
| Balancing Total Congestion Costs | Balancing Load Congestion Payments - Balancing Generation Congestion Credits + Balancing Explicit Congestion Costs |
| Total Congestion Costs | Day-Ahead Total Congestion Costs + Balancing Total Congestion Costs |

| MWh Category | Definition |
|---|---|
| Day-Ahead Demand MWh | Cleared Demand, Decrement Bids, Energy Sale Transactions |
| Day-Ahead Supply MWh | Cleared Generation, Increment Bids, Energy Purchase Transactions |
| | |
| Real-Time Demand MWh | Load and Energy Sale Transactions |
| Real-Time Supply MWh | Generation and Energy Purchase Transactions |
| | |
| Balancing Demand MWh | Real-Time Demand MWh - Day-Ahead Demand MWh |
| Balancing Supply MWh | Real-Time Supply MWh - Day-Ahead Supply MWh |